



File NO:

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SPECIFICATIONS

FOR RECHARGEABLE IRON PHOSPHATE LITHIUM-ION BATTERY

MODEL: F20-10150225

CAPACITY: 20.0Ah

CUSTOMER: _____

CUSTOMER
CONFIRM: _____

DATE: _____

PREPARED	CHECKED	APPROVED

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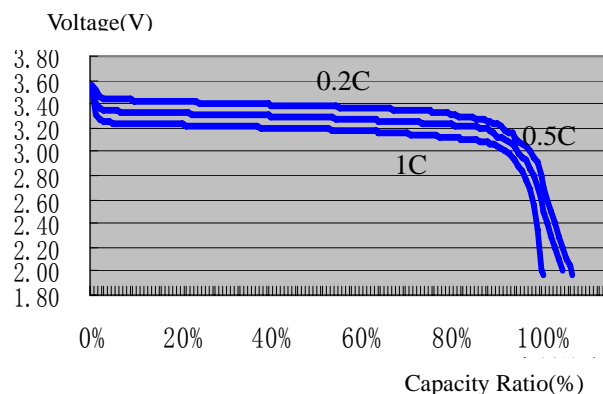
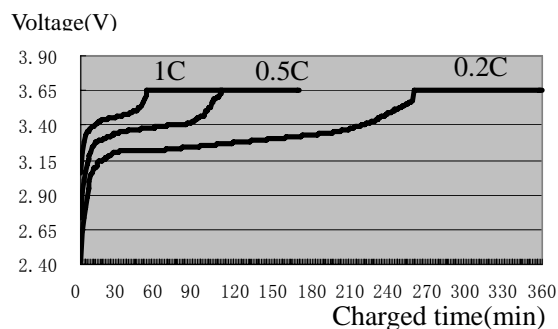
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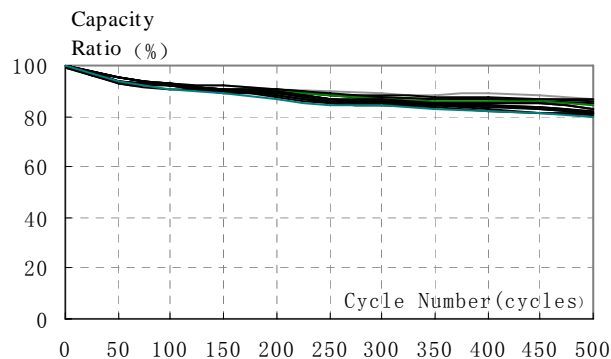
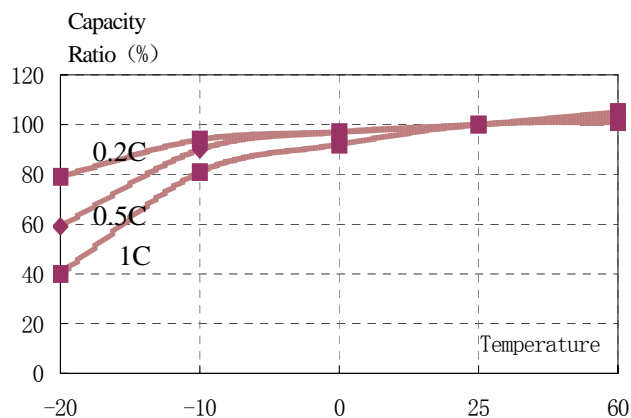
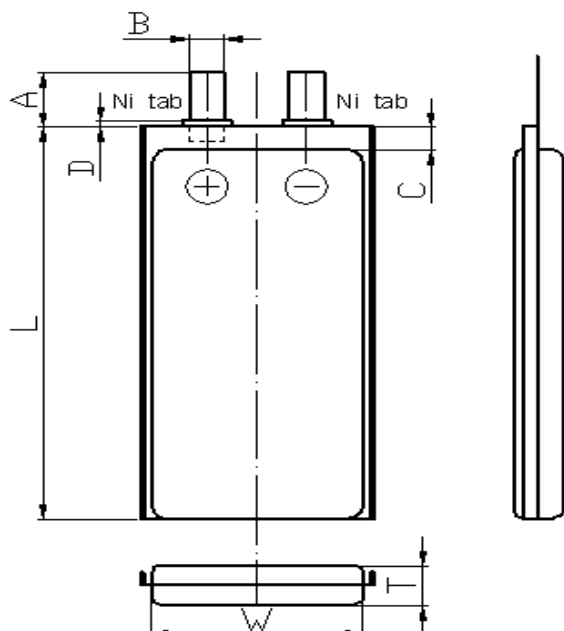
1.0 SPECIFICATIONS

Model	F20-10150225	
Case Material	Plastic-aluminum	
Rated Capacity	20.0Ah	
Nominal Voltage	3.2 V	
Max. Charge Voltage	3.65V	
Cut-off Discharge Voltage	2.0V	
Max. Charge Current	1 C	
Max. Discharge Current	2 C	
Maximum instant current/time	3C / 30s	
Weight (Approx.)	590±10g	
Impedance (at 1000Hz.)	≤8 mΩ (charged state)	
Charge Method (CC/CV)	Standard	0.2 C×6.5hrs
	Quick	1 C×2.5hrs.
Operating Temperature	Charge	0℃~45℃ 32°F~113°F
	Discharge	-20℃~60℃ -4°F~140°F
	Storage	-20℃~45℃ -4°F~113°F

3.0 CHARACTERISTIC CURVES



2.0 CONFIGURATION



Item	Specification
T	10 ±0.3mm
W	150±0.5 mm
L	225±0.5 mm
B	30±0.2 mm
A	15~50mm

4.0

CHARACTERISTICS

Prior to charging, the cell should have been discharged at the condition of $25 \pm 10^{\circ}\text{C}$, 86Kpa-106 Kpa and relative humidity of 45%-75% at a constant current of 0.2C down to 2.0V.

4.1 Electrochemical Characteristic

NO.	Item	Standard	Test Method
1	Discharge performance at 25°C	Discharge capacity / Nominal capacity $\times 100\%$ A) $0.2\text{C} \geq 100\%$ B) $1\text{C} \geq 85\%$ The curves of charging and discharging should be smooth.	Standard charge at 1C under the condition of normal atmospheric pressure and the environmental temperature of $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ and 45% ~ 75% RH (unless otherwise specified, storage and charging should be conducted as this regime), then rest for 10min and discharge at 0.2C、1C to 2.0V respectively. Charge/discharge cycle can be conducted for 3 times before meeting the Standards (the same below).
2	Charge (capacity) retention and recovery	Residual capacity \geq Nominal capacity $\times 85\%$ Recoverable capacity \geq Nominal capacity $\times 90\%$	The charged battery was Stored for 28 days, then discharge at 0.2C to 2.0V measuring residual capacity; 1C/0.2C measure recoverable capacity. Charge/discharge cycle can be conducted for 3 times before meeting the Requirements.
3	Cycle Life	Capacity \geq Nominal capacity $\times 80\%$	Measure initial status and initial capacity, then conduct 1C/1C cycle for 1500 times and measure final status.



4	Long Time Storage	Recoverable capacity \geq Nominal capacity $\times 80\%$	The battery was stored at 50% DOD for 12 months at room temperature, then measure the battery capacity by conducting 1C/0.2C cycle. The cycle may repeat for 5 times before meeting the Requirements.
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4.2 Safety Characteristic

Warning: These tests use procedures may result in harm if adequate precautions are not taken. Tests should only be performed by qualified and experienced technicians using adequate precaution.

NO.	Item	Standard	Test Method
1	Crush	No fire/explosion	Measure initial status. Standard charge. Keep the battery connected with a thermocouple and put it into two iron sheets (the biggest surface of the battery should be parallel to the surface of the crush platform) . Apply 13KN force to crush instantly. Observe the variation of the battery's appearance.
2	Hot Oven	No fire/explosion	The cell should be placed in a gravity or circulating air-convection oven. The oven temperature should be increased at a rate of $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ per minute until the oven reaches $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The cell remains at this temperature for 30 min before the test is discontinued.
3	Overcharge	No fire/ explosion	Battery charged with 3 C for 7h or the battery voltage not increase, the maximum charge voltage was set at 10V.
4	Over Discharge	No fire/ explosion	Battery charged with 1 C for 90min at the opposite direction.



5	Short Circuit at Room Temperature	No fire/explosion Max. temperature< 150℃	Charge the battery with the standard measure. Keep the battery into a ventilation cabinet and short-circuit the positive and negative terminals directly (general resistance should be less than or equal to 100mΩ). Observe the temperature change during the test. Stop the test when the output charge of the battery lower than 0.1V and the appearance temperature of the battery falls to less than 10℃ above the environment temperature.
6	Short Circuit at High Temperature	No fire/explosion Max. temperature< 150℃	Charge the battery with the standard measure. Keep the battery into a ventilation cabinet of 55 ± 5 ℃ and stored for 1.5-2h. Short-circuit the positive and negative terminals directly (general resistance should be less than or equal to 100mΩ) at this temperature. Observe the temperature change during the test. Stop the test when the temperature of the battery falls to 10℃ lower than that of the environment and the output charge of the battery lower than 0.1V.
7	Nail Penetration	No fire/explosion Max. temperature< 150℃	Charge the battery with the standard measure. Keep the battery connected with a thermocouple on a nail penetration apparatus, then penetrate through it with a 3mm diameter nail near the center of its biggest surface at the rate of 20mm/s-40mm/s and keep for 1min. Observe the variation of the battery's appearance and temperature.
8	Impact	No fire/explosion	Charge the battery with the standard measure. Keep the battery connected with a thermocouple and put it on a impaction platform, place a 15.8mm diameter bar across the center of the biggest surface, then let a 9.1kg heavy hammer self fall off to the platform from a height of 610mm. Observe the variation of the battery's appearance.

4.3 Adaptation to Environment Characteristic

Warning: These tests use procedures may result in harm if adequate precautions are not taken. Tests should only be performed by qualified and experienced technicians using adequate precaution.



NO.	Item	Standard	Test Method
1	Thermal Cycle	Recoverable capacity \geq Nominal capacity *80% No diformation/smoking/ explosion	The charged battery was stored at 75℃ for 48h, then stored at -20℃ for 6h and then stored at 25 ± 10 ℃ for 1-4h. The battery was discharged to 2.0V at ambient temperature. Measure the battery capacity using 1C/0.2C test.
2	Drop	No leakage/smoking /fire/explosion	Charge the battery with the standard measure. Then let it self fall off from a height of 1m(the lowest height) to a smooth concrete surface. The drop is implemented totally for 6 times.
3	High-low Temperature Discharge	Discharge capacity/ Nominal Capacity $\times 100\%$ A) 0℃: $\geq 80\%$; B) -20℃: $\geq 60\%$. No remarkable deformation, No leakage /smoking /fire /explosion	The charged battery was stored at $0 \text{ } ^\circ\text{C} \pm 2^\circ\text{C}$ and $-20 \text{ } ^\circ\text{C} \pm 2^\circ\text{C}$ for 16hs respectively, then discharge the battery with 0.2C to 2.0V.
4	Vibration	No remarkable deformation, No leakage / smoking/ fire/explosion	Charge the battery with the standard measure. Fix it on the vibration platform, adjust and prepare the test equipment according to following vibration frequency and relevant swing, doing frequency sweeping from X, Y, Z three directions, each from 10Hz to 55Hz for 30 minutes of recycling, rating of which is 1oct/min: A)vibration frequency:10Hz~30Hz Displacement breadth (single swing): 0.36mm B) vibration frequency: 30Hz~55Hz Displacement breadth(single swing): 0.36mm。
5	Altitude simulation (low pressure)	No leakage /fire/ explosion	The cell should be placed, at an ambient temperature of $20 \text{ } ^\circ\text{C} \pm 5^\circ\text{C}$, in a vacuum chamber from which the air is subsequently evacuated until the pressure equal to or less than 11.6kPa and held at that pressure for 6 h.

Comments: the definitions of some nomenclatures of this specification

- (1) 1C Standard Charge: Charge with current $1C_5A$ to limit charge voltage 3.65V under the condition of $20^\circ\text{C} \pm 5^\circ\text{C}$ surrounding temperature, then change to charge with constant voltage till the current less than or

equal to 0.01 C₅A.

- (2) Residual Capacity: The first discharge capacity after being tested by the specific procedure.
- (3) Recovery Capacity: The discharge capacity by implementing charge-discharge cycle repeatedly after being tested by the specific procedure.
- (4) 1C/1C (1C/0.5C、1C/0.2C): Charge at 1C₅A to limit charge voltage 3.65V, then change to charge with constant voltage until the current less than or equal to 0.01 C₅A, rest for 5min, then discharge at 1C₅A(0.5C₅A、0.2C₅A) to 2.0V cut-off.

5.0 WARRANTY PERIOD& PRODUCT LIABILITY

Warranty period of this product is 12 months from manufacturing code.

Shandong RealForce Enterprises Co., LTD is not responsible for the troubles caused by mishandling of the battery which is clearly against the instructions in this specification.

When Shandong RealForce Enterprises Co., LTD find any new facts which require modification of this document, we will inform you.

6.0 INDICATIONS ON BATTERY PACK

The following warnings should be indicated on the battery packs

- Use a specified charger
- Do not throw the battery into fire or heat
- Do not short-circuit the battery terminals
- Do not disassemble the battery

7.0 WARNINGS AND CAUTIONS IN USING THE BATTERY

To prevent a possibility of the battery from leaking, heating or explosion please observe the following precautions:

WARNINGS!

- Do not immerse the battery in water or seawater, and keep the battery in a cool dry surrounding if it stands by.
- Do not use or leave the battery near a heat source as fire or heater.
- Use the battery charger specifically for that purpose when recharging.
- Do not reverse the position and negative terminals.
- Do not connect the battery to an electrical outlet.
- Do not discard the battery in fire or a heater.
- Do not short-circuit the battery by directly connecting the positive and negative terminals with metal objects.
- Do not transport or store the battery together with metal objects such as hairpins, necklaces, etc.
- Do not strike, trample or throw the battery.
- Do not directly solder the battery and pierce the battery with a nail or other sharp objects.

CAUTIONS!

- Do not use or leave the battery at high temperature (for example, at strong direct sunlight or in a vehicle in extremely hot weather). Otherwise, it can overheat or fire or its performance will be degenerate and its service life will be decreased.
- Do not use the battery in a location where static electricity and magnetic field is great, otherwise, the safety devices may be damaged, causing hidden trouble of safety.
- If the battery leaks, and the electrolyte get into the eyes, do not rub the eyes, instead, rinse the eyes with clean water, and immediately seek medical attention. Otherwise, it may injure eyes.



- If the battery gives off an odor, generates heat, becomes discolored or deformed, or in any way appear abnormal during use, recharging or storage, immediately remove it from the device or battery charger and stop using it.
- In case the battery terminals are dirty, clean the terminals with a dry cloth before use. Otherwise performance may occur due to the poor connection with the instrument.
- Be aware discarded batteries may cause fire or explosion, tape the battery terminals to insulate them.